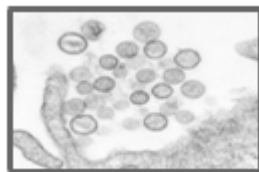


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National Center for Infectious Diseases

Special Pathogens Branch

# All About Hantaviruses

[All About Hantaviruses Home](#) | [General Information](#)  
[Technical Information](#) | [Contact Us](#)

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## General Information

**For general interest readers, students, and others**  
**Printer-Friendly Version**

[Back to General Information Index](#)

### Tracking a Mystery Disease: A Brief History of Hantavirus Pulmonary Syndrome

When did we first hear about hantavirus? What has happened since the first cases made national headlines? Learn about how researchers from many different institutions joined together to hunt down the source of the deadly illness.

### How Is the Virus That Causes HPS Transmitted? The Rodent Connection

Rodents, particularly the deer mouse and cotton rat, are the ultimate source of the disease. Learn how people get the virus from them!

### Who Is at Risk of Getting HPS, and Why?

Find out who gets the disease and why. What does being "at risk" mean?

### What are the Symptoms of HPS?

What signs and symptoms are important to know? What symptoms aren't?

### How Do I Prevent HPS?

Prevention is your best bet for dealing with HPS. That means keeping rodents out of homes and workplaces, keeping away from rodents when camping or hiking, and cleaning up safely if you do find rodents. Our prevention pages have complete tips and instructions for all kinds of people, and all kinds of problems and concerns.

### Treating Hantavirus Pulmonary Syndrome

There is no miracle drug to cure HPS. Instead, patients should get immediate intensive care. What does this involve?

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## Tracking a Mystery Disease:

## **The Detailed Story of Hantavirus Pulmonary Syndrome**

### **The "First" Outbreak**

In May 1993, an outbreak of an unexplained pulmonary illness occurred in the southwestern United States, in an area shared by Arizona, New Mexico, Colorado and Utah known as "The Four Corners." A young, physically fit Navajo man suffering from shortness of breath was rushed to a hospital in New Mexico and died very rapidly.

While reviewing the results of the case, medical personnel discovered that the young man's fiancée had died a few days before after showing similar symptoms, a piece of information that proved key to discovering the disease. As Dr. James Cheek of the Indian Health Service (IHS) noted, "I think if it hadn't been for that initial pair of people that became sick within a week of each other, we never would have discovered the illness at all."

An investigation combing the entire Four Corners region was launched by the New Mexico Office of Medical Investigations (OMI) to find any other people who had a similar case history. Within a few hours, Dr. Bruce Tempest of IHS, working with OMI, had located five young, healthy people who had all died after acute respiratory failure.

A series of laboratory tests had failed to identify any of the deaths as caused by a known disease, such as bubonic plague. At this point, the CDC Special Pathogens Branch was notified. CDC, the state health departments of New Mexico, Colorado and Utah, the Indian Health Service, the Navajo Nation, and the University of New Mexico all joined together to confront the outbreak.

During the next few weeks, as additional cases of the disease were reported in the Four Corners area, physicians and other scientific experts worked intensively to narrow down the list of possible causes. The particular mixture of symptoms and clinical findings pointed researchers away from possible causes, such as exposure to a herbicide or a new type of influenza, and toward some type of virus. Samples of tissue from patients who had gotten the disease were sent to CDC for exhaustive analysis. Virologists at CDC used several tests, including new methods to pinpoint virus genes at the molecular level, and were able to link the pulmonary syndrome with a virus, in particular a previously unknown type of hantavirus.

### **Researchers Launch Investigations to Pin Down the Carrier of the New Virus**

Researchers knew that all other known hantaviruses were transmitted to people by rodents, such as mice and rats. Therefore, an important part of their mission was to trap as many different species of rodents living in the Four Corners region as possible to find the particular type of rodent that carried the virus. From June through mid-August of

1993, all types of rodents were trapped inside and outside homes where people who had hantavirus pulmonary syndrome had lived, as well as in piñon groves and summer sheep camps where they had worked. Additional rodents were trapped for comparison in and around nearby households as well. Taking a calculated risk, researchers decided not to wear protective clothing or masks during the trapping process. "We didn't want to go in wearing respirators, scaring...everybody," John Sarisky, an Indian Health Service environmental disease specialist said. However, when the almost 1,700 rodents trapped were dissected to prepare samples for analysis at CDC, protective clothing and respirators were worn.

Among rodents trapped, the deer mouse (*Peromyscus maniculatus*) was found to be the main host to a previously unknown type of hantavirus. Since the deer mouse often lives near people in rural and semi-rural areas—in barns and outbuildings, woodpiles, and inside people's homes—researchers suspected that the deer mouse might be transmitting the virus to humans. About 30% of the deer mice tested showed evidence of infection with hantavirus. Tests also showed that several other types of rodents were infected, although in lesser numbers.

The next step was to pin down the connection between the infected deer mice and households where people who had gotten the disease lived. Therefore, investigators launched a case-control investigation. They compared "case" households, where people who had gotten the disease lived, with nearby "control" households. Control households were similar to those where the case-patients lived, except for one factor: no one in the control households had gotten the disease.

The results? First, investigators trapped more rodents in case households than in control households, so more rodents may have been living in close contact with people in case households. Second, people in case households were more likely than those in control households to do cleaning around the house or to plant in or hand-plow soil outdoors in fields or gardens. However, it was unclear if the risk for contracting HPS was due to performing these tasks, or with entering closed-up rooms or closets to get tools needed for these tasks.

In November 1993, the specific hantavirus that caused the Four Corners outbreak was isolated. The Special Pathogens Branch at CDC used tissue from a deer mouse that had been trapped near the New Mexico home of a person who had gotten the disease and grew the virus from it in the laboratory. Shortly afterwards and independently, the U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID) also grew the virus, from a person in New Mexico who had gotten the disease as well as from a mouse trapped in California.

The new virus was called Muerto Canyon virus—later changed to Sin Nombre virus (SNV)—and the new disease caused by the virus was named hantavirus pulmonary syndrome, or HPS.

The isolation of the virus in a matter of months was remarkable. This success was based on close cooperation of all the agencies and individuals involved in investigating the outbreak, years of basic research on other hantaviruses that had been conducted at CDC and USAMRIID, and on the continuing development of modern molecular virologic tests. To put the rapid isolation of the Sin Nombre virus in perspective, it took several decades for the first hantavirus discovered, the Hantaan virus, to be isolated.

### **HPS Not Really a New Disease**

As part of the effort to locate the source of the virus, researchers located and examined stored samples of lung tissue from people who had died of unexplained lung disease. Some of these samples showed evidence of previous infection with Sin Nombre virus—indicating that the disease had existed before the "first" known outbreak—it simply had not been recognized!

Other early cases of HPS have been discovered by examining samples of tissue belonging to people who had died of unexplained adult respiratory distress syndrome. By this method, the earliest known case of HPS that has been confirmed has been the case of a 38-year-old Utah man in 1959.

Interestingly, while HPS was not known to the epidemiologic and medical communities, there is evidence that it was recognized elsewhere. The Navajo Indians, a number of whom contracted HPS during the 1993 outbreak, recognize a similar disease in their medical traditions, and actually associate its occurrence with mice. As strikingly, Navajo medical beliefs concur with public health recommendations for preventing the disease.

### **Why Did the Outbreak Occur in the Four Corners Area?**

But why this sudden cluster of cases? The key answer to this question is that, during this period, there were suddenly many more mice than usual. The Four Corners area had been in a drought for several years. Then, in early 1993, heavy snows and rainfall helped drought-stricken plants and animals to revive and grow in larger-than-usual numbers. The area's deer mice had plenty to eat, and as a result they reproduced so rapidly that there were ten times more mice in May 1993 than there had been in May of 1992. With so many mice, it was more likely that mice and humans would come into contact with one another, and thus more likely that the hantavirus carried by the mice would be transmitted to humans.

### **Person-to-Person Spread of HPS Decided Unlikely**

"Although person-to-person spread [of HPS] has not been documented with any of the other known hantaviruses, we were concerned [during this outbreak] because we were

dealing with a new agent," said Charles Vitek, a CDC medical investigator.

Researchers and clinicians investigating the ongoing outbreak were not the only groups concerned about the disease. Shortly after the first few HPS patients died and it became clear that a new disease was affecting people in the area, and that no one knew how it was transmitted, the news media began extensive reporting on the outbreak. Widespread concern among the public ensued.

Unfortunately, the first victims of the outbreak were Navajo. News reports focused on this fact, and the misperception grew that the unknown disease was somehow linked to Navajos. As a consequence, Navajos found themselves at the center of intense media attention and the objects of the some people's fears.

By later in the summer of 1993, the media frenzy had quieted somewhat, and the source of the disease was pinpointed. Researchers determined that, like other hantaviruses, the virus that causes HPS is not transmitted from person to person the way other infections, such as the common cold, may be.

To date, no cases of HPS have been reported in the United States in which the virus was transmitted from one person to another. In fact, in a study of health care workers who were exposed to either patients or specimens infected with related types of hantaviruses (which cause a different disease in humans), none of the workers showed evidence of infection or illness.

## **HPS Since the First Outbreak**

After the initial outbreak, the medical community nationwide was asked to report any cases of illness with symptoms similar to those of HPS that could not be explained by any other cause. As a result, additional cases have been reported.

Since 1993, researchers have discovered that there is not just one hantavirus that causes HPS, but several. In June 1993, a Louisiana bridge inspector who had not traveled to the Four Corners area developed HPS. An investigation was begun. The patient's tissues were tested for the presence of antibodies to hantavirus. The results led to the discovery of another hantavirus, named Bayou virus, which was linked to a carrier, the rice rat (*Oryzomys palustris*). In late 1993, a 33-year-old Florida man came down with HPS symptoms; he later recovered. This person also had not traveled to the Four Corners area. A similar investigation revealed yet another hantavirus, named the Black Creek Canal virus, and its carrier, the cotton rat (*Sigmodon hispidus*). Another case occurred in New York. This time, the Sin Nombre-like virus was named New York-1, and the white-footed mouse, *Peromyscus leucopus*, was implicated as the carrier.

More recently, cases of HPS stemming from related hantaviruses have been documented

in Argentina, Brazil, Canada, Chile, Paraguay, and Uruguay, making HPS a pan-hemispheric disease.

## References

Information for this page was developed using the CDC video *Preventing Hantavirus Disease* and resource articles listed in the bibliography.

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## How Is Hantavirus Transmitted?

In the United States, deer mice (along with cotton rats and rice rats in the southeastern states and the white-footed mouse in the Northeast) carry hantaviruses that cause hantavirus pulmonary syndrome. Learn more about the rodent carriers of HPS.

Rodents shed the virus in their urine, droppings, and saliva. The virus is mainly transmitted to people when they breathe in air contaminated with the virus.

When fresh rodent urine, droppings or nesting materials are stirred up, tiny droplets containing the virus get into the air. This process is known as "aerosolization."

There are several other ways rodents may spread hantavirus to people:

- If a rodent with the virus bites someone, the virus may be spread to that person—but this type of transmission is rare.
- Researchers believe that people may be able to get the virus if they touch something that has been contaminated with rodent urine, droppings, or saliva, and then touch their nose or mouth.
- Researchers also suspect people can become sick if they eat food contaminated by urine, droppings, or saliva from an infected rodent.

## Can You Get Hantavirus from Another Person?

The types of hantavirus that cause HPS in the United States cannot be transmitted from one person to another. For example, you cannot get the virus from touching or kissing a person who has HPS or from a health care worker who has treated someone with the disease. You also cannot get the virus from a blood transfusion in which the blood came from a person who became ill with HPS and survived.

## Can You Get Hantavirus from Animals Other Than Rodents, or from Insects? What About Pets?

No-the hantaviruses that cause HPS in the United States are not known to be transmitted by any types of animals other than certain species of rodents. You cannot get hantavirus from farm animals, such as cows, chickens, or sheep, or from insects, such as mosquitoes. Dogs and cats are not known to carry hantavirus; however, they may bring infected rodents into contact with people if they catch such animals and carry them home. Guinea pigs, hamsters, gerbils, and rodents from pet stores are not known to carry hantavirus.

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## Here are the Rodents That Carry the Types of Hantavirus Which Cause HPS in the United States:



*deer mouse*

**The Deer Mouse** (*Peromyscus maniculatus*) is a deceptively cute animal, with big eyes and big ears. Its head and body are normally about 2 - 3 inches long, and the tail adds another 2 - 3 inches in length. You may see it in a variety of colors, from gray to reddish brown, depending on its age. The underbelly is always white and the tail has sharply defined white sides. The deer mouse is

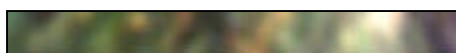
found almost everywhere in North America. Usually, the deer mouse likes woodlands, but also turns up in desert areas.



*cotton rat*

**The Cotton Rat** (*Sigmodon hispidus*), which you'll find in the southeastern United States (and way down into Central and South America), has a bigger body than the deer mouse—head and body about 5 - 7 inches, and another 3 - 4 inches for the tail. The hair is longer and coarser, of a grayish brown color, even grayish black. The cotton rat prefers overgrown areas with shrubs and tall

grasses.



*rice rat*

**The Rice Rat** (*Oryzomys palustris*) is slightly smaller than the cotton rat, having a head and body 5 - 6 inches long, plus a very long, 4- to 7-inch tail. Rice rats sport short, soft, grayish brown fur on top, and gray or tawny underbellies. Their feet are whitish. As you might expect from the name, this rat likes marshy areas and is semiaquatic. It's found in the southeastern United States and in Central America.



*white-footed mouse*

**The White-footed Mouse** (*Peromyscus leucopus*) is hard to distinguish from the deer mouse. The head and body together are about four inches long. Note that its tail is normally shorter than its body (about 2 - 4 inches long). Topside, its fur ranges from pale brown to reddish brown, while its underside and feet are white. The white-footed mouse is found through southern New England, the Mid-

Atlantic and southern states, the midwestern and western states, and Mexico. It prefers wooded and brushy areas, although sometimes it will live in more open ground.

Both the deer mouse and the cotton rat usually live in rural areas, but can also be found in cities when conditions are right, such as easy availability of food, water and shelter.

(Remember this point when it comes to "discouraging" rodents, which is discussed under "How Do I Prevent HPS").

### **Other Rodents May Also Carry Hantavirus**

Other rodents carry strains of hantavirus that cause HPS, but they have not yet been identified. In addition, other rodent species may play host to other types of hantaviruses that cause a different type of infection, hemorrhagic fever with renal syndrome, or HFRS. See "hantavirus" for more information.

It is wise, therefore, to avoid close contact with rodents in general.

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## **Transmission Details: So How Does "Aerosolization" Really Work?**

For a hantavirus to cause HPS, the virus must travel from the rodents that carry it to a

person. A common way this happens is when a person breathes in the hantavirus from the air.

Let's create an imaginary scenario and go through the process step by step. Say you have a storage room in your home that you hardly ever enter. You keep old furniture there, old newspapers and magazines, and so on. At some point, a group of deer mice find their way into the room, looking for places to build nests. They found their way into the room through a crack—deer mice can squeeze through holes as small as a shirt button! Some mice chew through the fabric of an old armchair and build a nest inside it. Other mice shred bits of magazines and build nests under the shredded pieces.

A few of these mice are infected with the hantavirus. The infected mice don't show any signs of being sick. In fact, the virus does not seem to make them ill at all; it simply lives in their bodies. However, the virus is shed continuously from them: into the droppings and urine they leave around the room, and into their saliva, which dries on anything they have chewed, such as nesting material. Out in the environment like this, the virus can live for several days.

Meanwhile, you decide to clean up your storage room. You go inside, spend a few minutes moving boxes and furniture. The mice hear you coming and scurry away, leaving a trail of fresh urine! Because you find mouse droppings and some of the furniture stuffing the mice have used as nesting material, you get a broom and sweep up the mess. As you move around and sweep, tiny particles of fresh urine, droppings and saliva, with the virus in them, get kicked up into the air. This is the aerosolization. It is these tiny particles that you breathe in—and this is the beginning of becoming sick with HPS.

Because the virus is spread when virus-containing particles are stirred up into the air, an essential HPS tactic in areas showing signs of rodents is to avoid actions that raise dust and to carefully wet the area down with disinfectant. The less chance the virus has to get into the air, the less chance it will be breathed in!

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## **Who Is at Risk of Getting HPS, and Why?**

Anyone who comes into contact with rodents that carry hantavirus is at risk of HPS. Rodent infestation in and around the home remains the primary risk for hantavirus exposure. Even healthy individuals are at risk for HPS infection if exposed to the virus.

## **What Kind of Activities Are Risky?**

Any activity that puts you in contact with rodent droppings, urine, saliva, or nesting materials can place you at risk for infection. Hantavirus is spread when virus-containing particles from rodent urine, droppings, or saliva are stirred into the air. It is important to avoid actions that raise dust, such as sweeping or vacuuming. Infection occurs when you breathe in virus particles.

### **Opening and Cleaning Previously Unused Buildings**

Opening or cleaning cabins, sheds, and outbuildings, including barns, garages and storage facilities, that have been closed during the winter is a potential risk for hantavirus infections, especially in rural settings.

### **Housecleaning Activities**

Cleaning in and around your own home can put you at risk if rodents have made it their home too. Many homes can expect to shelter rodents, especially as the weather turns cold. Please see our prevention information on how to properly clean rodent-infested areas.

### **Work-related Exposure**

Construction, utility and pest control workers can be exposed when they work in crawl spaces, under houses, or in vacant buildings that may have a rodent population.

### **Campers and Hikers**

Campers and hikers can also be exposed when they use infested trail shelters or camp in other rodent habitats.

The chance of being exposed to hantavirus is greatest when people work, play, or live in closed spaces where rodents are actively living. However, recent research results show that many people who have become ill with HPS were infected with the disease after continued contact with rodents and/or their droppings. In addition, many people who have contracted HPS reported that they had not seen rodents or their droppings before becoming ill. Therefore, if you live in an area where the carrier rodents, such as the deer mouse, are known to live, take sensible precautions-even if you do not see rodents or their droppings.

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## **What Are The Symptoms of HPS?**

### **Early symptoms**

Early symptoms include fatigue, fever and muscle aches, especially in the large muscle groups-thighs, hips, back, and sometimes shoulders. These symptoms are universal.

There may also be headaches, dizziness, chills, and abdominal problems, such as nausea, vomiting, diarrhea, and abdominal pain. About half of all HPS patients experience these symptoms.

### **Late symptoms**

Four to 10 days after the initial phase of illness, the late symptoms of HPS appear. These include coughing and shortness of breath, with the sensation of, as one survivor put it, a "...tight band around my chest and a pillow over my face" as the lungs fill with fluid.

### **Uncommon symptoms**

Earache, sore throat, runny nose, and rash are very uncommon symptoms of HPS.

### **How long after contracting the virus do symptoms appear?**

Due to the small number of HPS cases, the "incubation time" is not positively known. However, on the basis of limited information, it appears that symptoms may develop between 1 and 5 weeks after exposure to urine, droppings, or saliva of infected rodents.

Another important point to remember from the data that the CDC Special Pathogens Branch keeps on all reported cases of HPS, is that it appears many people who have become ill were in a situation where they did not see rodents or rodent droppings. Other people have had frequent contact with rodents and their droppings before becoming ill. This apparent inconsistency makes it very difficult to pin down the precise time when the virus was transmitted.

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## **How Do I Prevent HPS?**

Eliminate or minimize contact with rodents in your home, workplace, or campsite. If rodents don't find that where you are is a good place for them to be, then you're less likely to come into contact with them. Seal up holes and gaps in your home or garage. Place traps in and around your home to decrease rodent infestation. Clean up any easy-to-get food.

Recent research results show that many people who became ill with HPS developed the disease after having been in frequent contact with rodents and/or their droppings around a home or a workplace. On the other hand, many people who became ill reported that they had not seen rodents or rodent droppings at all. Therefore, if you live in an area where the carrier rodents are known to live, try to keep your home, vacation place, workplace, or campsite clean.

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## Prevention Indoors and Outdoors

### Indoors:

- Keep a clean home, especially kitchen (wash dishes, clean counters and floor, keep food covered in rodent-proof containers).
- Keep a tight-fitting lid on garbage, discard uneaten pet food at the end of the day.
- Set and keep spring-loaded rodent traps. Set traps near baseboards because rodents tend to run along walls and in tight spaces rather than out in the open.
- Set Environmental Protection Agency-approved rodenticide with bait under plywood or plastic shelter along baseboards. These are sometimes known as "covered bait stations." Remember to follow product use instructions carefully, since rodenticides are poisonous to pets and people, too.
- Seal all entry holes 1/4 inch wide or wider with lath screen or lath metal, cement, wire screening or other patching materials, inside and out.

If bubonic plague is a problem in your area, spray flea killer or spread flea powder in the area before setting traps. This is important. If you control rodents but do not control fleas as well, you may increase the risk of infection with bubonic plague, since fleas will leave rodents once the rodents die and will seek out other food sources, including humans.

### Outdoors:

- Clear brush, grass and junk from around house foundations to eliminate a source of nesting materials.
  - Use metal flashing around the base of wooden, earthen or adobe homes to provide a strong metal barrier. Install so that the flashing reaches 12 inches above the ground and six inches down into the ground.
  - Elevate hay, woodpiles and garbage cans to eliminate possible nesting sites. If possible, locate them 100 feet or more from your house.
  - Trap rodents outside, too. Poisons or rodenticides may be used as well, but be sure to keep them out of the reach of children or pets.
  - Encourage the presence of natural predators, such as non-poisonous snakes, owls and hawks.
  - Remember, getting rid of all rodents isn't feasible, but with ongoing effort you can keep the population very low.
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## Some Common Signs of Rodent Infestation

**Remember that not all types of rodents carry hantavirus. Neither common house mice nor common rats have been associated with HPS in humans, for example. Yet because it can be tough to tell just what kind of rodents you have, play it safe -- clean up the infestation and rodent-proof your home or workplace.**

Here are some common signs that you may have a rodent problem.

### Rodent Droppings

This is one of the most reliable signs that you have a rodent problem. You may find droppings in places where you store your food or your pet/animal food, such as in cupboards and drawers or in bins. Because mice like to run in places that offer them some protection from predators, you may find droppings in cupboards or under the sink, along walls, or on top of wall studs or beams. Mice will leave droppings near their nests as well (see below). Storage rooms, sheds, barns, or cabins loaded with boxes, bags, old furniture, and other objects make an ideal home for rodents, so you may find droppings there, even inside boxes and other containers.

Workplaces can also make good rodent homes. Warehouses, restaurants, and the like are obvious places to look because food may be plentiful there. However, rodents can infest office buildings, too. Once again, look for droppings in protected places, such as closets, storage rooms, or inside boxes.

### Signs of Rodent Nests

Rodents tend to build their nests from materials that are soft, fuzzy, or warm. Among common rodent nest materials are shredded paper, bunches of dry grass or small twigs, fabric, and furniture stuffing. Rodents will nest wherever safety from enemies can be found close enough to food and water, and they prefer places that are relatively quiet. Inside buildings, here are some places to look:

- inside cabinets
- under or inside dressers
- in and among boxes
- behind and inside machinery and appliances (kitchen appliances such as stoves or refrigerator drip pans; water coolers; and electric motor cases or computer cases)
- inside upholstered furniture
- inside double walls or the space between floors and ceilings.

### Food Boxes, Containers, or Food Itself That Appears To Be Nibbled

Look for droppings nearby. Rodents can chew through plastic, so plastic bags do not

make safe food storage containers.

### **Signs of Rodent "Feeding Stations"**

These are semi-hidden spots where rodents eat food they have collected. At these stations, rodents may leave larger-than-normal amounts of droppings/urine, plus remnants of a variety of foods (such as nut shells), bits of plastic or paper, and cockroach carcasses.

### **You Find Evidence of Gnawing**

To get to food, rodents will gnaw on almost anything that is softer than the enamel of their teeth. This includes such things as wood, paper board, cloth sacks, and materials even harder than these. Because rodents' teeth grow continuously, they must gnaw to keep them short. That may help to explain why chair legs or similar surfaces show gnawed spots or tooth marks in rodent-infested places.

### **You Notice an Odd, Stale Smell**

In closed-up rooms infested by rodents, you will commonly smell an unusual, musky odor.

### **You See a Mouse in Your House**

Rodents are normally active at night, and generally avoid humans. If you have rodents, unless the infestation is large, you may never see one.

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## **Clean Up Infested Areas, Using Safety Precautions:**

Put on latex rubber gloves before cleaning up.

**Do not** stir up dust by sweeping up or vacuuming up droppings, urine or nesting materials.

Instead, thoroughly wet contaminated areas with detergent or liquid to deactivate the virus. Most general purpose disinfectants and household detergents are effective. However, a hypochlorite solution prepared by mixing 1 and 1/2 cups of household bleach in 1 gallon of water may be used in place of commercial disinfectant. When using the chlorine solution, avoid spilling the mixture on clothing or other items that may be damaged.

Once everything is wet, take up contaminated materials with a damp towel, then mop or sponge the area with disinfectant.

Spray dead rodents with disinfectant, then double-bag along with all cleaning materials and bury or burn—or throw out in appropriate waste disposal system. If burning or burying isn't feasible, contact your local or state health department about other disposal methods.

Finally, disinfect gloves *before taking them off* with disinfectant or soap and water. After taking off the clean gloves, thoroughly wash hands with soap and warm water.

When going into cabins or outbuildings (or work areas) that have been closed for awhile, open them up and air out before cleaning.

## **Hantaviruses and Disinfectants**

Hantaviruses are surrounded by a lipid (fatty) envelope, so they are somewhat fragile. The lipid envelope can be destroyed and the virus killed by fat solvents, such as alcohol, ordinary disinfectants and household bleach. That is why one of the most important ways to prevent transmitting the disease is to carefully wet down dead rodents and areas where rodents have been with disinfectant and/or bleach. When you do this, you are killing the virus itself and reducing the chance that the virus will get into the air.

### [Strength and Quantity of Hypochlorite Solutions \(Bleach\)](#)

Special Pathogens Branch recommends a 10% bleach solution be used to inactivate hantaviruses.

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## **Special Precautions for Homes of Persons with Confirmed Hantavirus Infection or Buildings with Heavy Rodent Infestations**

Special precautions should be used for cleaning homes or buildings with heavy rodent infestations in areas where HPS has been reported. If you are attempting to deal with such an infestation, it is recommended that you contact the responsible local, state, or federal public health agency for guidance.

The special precautions may also apply to vacant dwellings that have attracted numbers of rodents while unoccupied and to dwellings and other structures that have been occupied by persons with confirmed hantavirus infection.

Workers who are either hired specifically to perform the clean-up or asked to do so as part of their work activities should receive a thorough orientation from the responsible health agency about hantavirus transmission and should be trained to perform the

required activities safely.

### **Precautions To Be Used:**

- Persons involved in the clean-up should wear coveralls (disposable, if possible), rubber boots or disposable shoe covers, rubber or plastic gloves, protective goggles, and an appropriate respiratory protection device, such as a half-mask air-purifying (or negative-pressure) respirator with a high-efficiency particulate air (HEPA) filter or a powered air-purifying respirator (PAPR) with HEPA filters.

Please note: the HEPA classification recently has been discontinued. Please read "Update On the Nomenclature and Use of Respirators as a Precaution for Hantavirus Infection, February, 1999" for details.

- Personal protective gear should be decontaminated upon removal at the end of the day. If the coveralls are not disposable, they should be laundered on site. If no laundry facilities are available, the coveralls should be immersed in liquid disinfectant until they can be washed.
  - All potentially infective waste material (including respirator filters) from clean-up operations that cannot be burned or deep buried on site should be double bagged in appropriate plastic bags. The bagged material should then be labeled as infectious (if it is to be transported) and disposed of in accordance with local requirements for infectious waste.
  - Workers who develop symptoms suggestive of HPS within 45 days of the last potential exposure should immediately seek medical attention. The physician should contact local health authorities promptly if hantavirus-associated illness is suspected. A blood sample should be obtained and forwarded with the baseline serum through the state health department to CDC for hantavirus antibody testing.
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### **Precautions for Workers in Affected Areas Who are Regularly Exposed to Rodents**

Persons who frequently handle or are exposed to rodents (e.g., mammalogists, pest-control workers) in the affected area are probably at higher risk for hantavirus infection than the general public because of their frequency of exposure. Therefore, enhanced precautions are warranted to protect them against hantavirus infection.

### **Precautions To Be Used:**

- Workers in potentially high-risk settings should be informed about the symptoms of the disease and be given detailed guidance on prevention measures.
- Workers who develop a febrile or respiratory illness within 45 days of the last potential exposure should immediately seek medical attention and inform the attending physician of the potential occupational risk of hantavirus infection. The physician should contact local health authorities promptly if hantavirus-associated illness is suspected. A blood sample should be obtained and forwarded with the baseline serum through the state health department to CDC for hantavirus antibody testing.
- Workers should wear a half-face air-purifying (or negative-pressure) respirator or PAPR equipped with HEPA filters when removing rodents from traps or handling rodents in the affected area. (Please note: the HEPA classification recently has been discontinued. Under the new classification system, the N-100 filter type is recommended. Read the Federal Occupational Safety and Health Administration (OSHA) directive online, at "OSHA Directives: CPL 2-0.120 - Inspection procedures for the Respiratory Protection Standard".), at [http://www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=DIRECTIVES&p\\_id=2275](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=DIRECTIVES&p_id=2275)
- Respirators (including positive-pressure types) are not considered protective if facial hair interferes with the face seal, since proper fit cannot be assured. Respirator use practices should be in accord with a comprehensive user program and should be supervised by a knowledgeable person.
- Workers should wear rubber or plastic gloves when handling rodents or handling traps containing rodents. Gloves should be washed and disinfected before removing them, as described above.
- Traps contaminated by rodent urine or feces or in which a rodent was captured should be disinfected with a commercial disinfectant or bleach solution. Dispose of dead rodents as described in the section on Eliminating Rodents inside the Home.
- Persons removing organs or obtaining blood from rodents in affected areas should contact the Special Pathogens Branch, Division of Viral and Rickettsial Diseases, National Center for Infectious Diseases, Centers for Disease Control and Prevention, [telephone (404) 639-1115] for detailed safety precautions.

## **Precautions for Other Occupational Groups Who Have Potential Rodent Contact**

Insufficient information is available at this time to allow general recommendations regarding risks or precautions for persons in the affected areas who work in occupations with unpredictable or incidental contact with rodents or their habitations. Examples of such occupations include telephone installers, maintenance workers, plumbers, electricians, and certain construction workers. Workers in these jobs may have to enter various buildings, crawl spaces, or other sites that may be rodent infested.

Recommendations for such circumstances must be made on a case-by-case basis after the specific working environment has been assessed and state or local health departments

have been consulted.

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## **Precautions for Campers and Hikers in the Affected Areas**

There is no evidence to suggest that travel into areas where HPS has been reported should be restricted. Most usual tourist activities pose little or no risk that travelers will be exposed to rodents or their urine and/or droppings.

However, persons who do outdoor activities such as camping or hiking in areas where the disease has been reported should take precautions to reduce the likelihood of their exposure to potentially infectious materials.

### **Useful Precautions:**

- Avoid coming into contact with rodents and rodent burrows or disturbing dens (such as pack rat nests).
  - Air out, then disinfect cabins or shelters before using them. These places often shelter rodents.
  - Do not pitch tents or place sleeping bags in areas in proximity to rodent droppings or burrows or near areas that may shelter rodents or provide food for them (e.g., garbage dumps or woodpiles).
  - If possible, do not sleep on the bare ground. In shelters, use a cot with the sleeping surface at least 12 inches above the ground. Use tents with floors or a ground cloth if sleeping in the open air.
  - Keep food in rodent-proof containers!
  - Promptly bury (or--preferably--burn followed by burying, when in accordance with local requirements) all garbage and trash, or discard in covered trash containers.
  - Use only bottled water or water that has been disinfected by filtration, boiling, chlorination, or iodination for drinking, cooking, washing dishes, and brushing teeth.
  - And last but not least, do not play with or handle any rodents that show up at the camping or hiking site, even if they appear friendly.
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## **Update On the Nomenclature and Use of Respirators as a Precaution for Hantavirus Infection**

## February, 1999

### The CDC **Interim Recommendations for Risk Reduction for Hantavirus Infection**

(1) describe precautions for persons who are involved in the cleanup of homes of confirmed cases of hantavirus infection or of areas with heavy rodent infestation and for workers in affected areas who are regularly exposed to rodents. Among these precautions is the wearing of one of the following types of respirators(2) equipped with a high-efficiency particulate air (HEPA) filter:



a) half-mask air-purifying (or negative-pressure) respirator



b) powered air-purifying respirator (PAPR)

Recent changes in the nomenclature and certification of the type of filters used in these respirators include the **discontinuation of the HEPA designation** and the designation of new classes of filters. As shown on the chart below, the N-100 (99.97) is equivalent to the previous HEPA filter.

**Use of an N-100 filter should provide the same protection as the HEPA filter. Due to the nature of the virus, no studies have been able to test the efficacy of either the HEPA or N-100 filters in protecting against HPS transmission. Available evidence suggests that HPS is transmitted**

**by inspiring small (less than 5 micron) viral particles in aerosols which the N-100 is the most effective in removing.**

**Cautions:** As described in CDC **Interim Recommendations for Risk Reduction for Hantavirus Infection**, all negative-pressure respirators are fit-dependent. Anything that interferes with the respirator's face seal, such as facial hair, will allow ambient air to bypass the filter medium in the respirator(3). Ideally, users should be fit-tested with the same make, model, style, and size of respirator that will be actually used. Respirator practices should follow a comprehensive user program and be supervised by a knowledgeable person.

### **New Classes of Filters for Respiratory Protection Devices(4)**

<i>New classes of filters ††</i>			<i>Characteristics</i>
		<b>Equivalent to HEPA</b>	
N-95	N-99	<b>N-100 (99.97)</b>	Not resistant to oil
R-95	R-99	<b>R-100 (99.97)</b>	Resistant to oil

P-95	P-99	<b>P-100 (99.97)</b>	Oil Proof
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†† number indicates % efficiency in removing monodispersed particles 0.3 micrometers in diameter.

Authority for testing and certifying these respirators has been given exclusively to NIOSH. For additional information:

- contact the Industrial Hygiene Section, Office of Health & Safety, CDC at 404 639-3112.
- Read the NIOSH directive online, at "OSHA Directives: CPL 2-0.120 - Inspection procedures for the Respiratory Protection Standard", at [http://www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=DIRECTIVES&p\\_id=2275](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=DIRECTIVES&p_id=2275)

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(1) *MMWR* Recommendations and Reports, July 30, 1993; 42 [RR-11]: 1-13)

(2) All of these respirators can be purchased from commercial suppliers of laboratory safety equipment. The items displayed here are intended to show the general design of the respirator and do not constitute endorsement of any particular brand of respirator.

(3) *MMWR* 47(40): 1045-1049, demonstrates importance of fit testing for all negative-pressure respirators.

(4) As described in NIOSH 42, CFR 84.

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## What Is the Treatment for HPS?

At the present time, there is no specific treatment or "cure" for hantavirus infection. However, we do know that if the infected individuals are recognized early and are taken to an intensive care unit, some patients may do better. In intensive care, patients are intubated and given oxygen therapy to help them through the period of severe respiratory distress.

The earlier the patient is brought in to intensive care, the better. If a patient is experiencing full distress, it is less likely the treatment will be effective.

Therefore, if you have been around rodents and have symptoms of fever, deep muscle aches and severe shortness of breath, see your doctor *immediately*. Be sure to tell your doctor that you have been around rodents—this will alert your physician to look closely for any rodent-carried disease such as HPS.

[Back to General Information Index](#)

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[CDC Home](#) | [Search](#) | [Health Topics A-Z](#)

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Infectious Disease Pathology Activity  
Division of Viral and Rickettsial Diseases  
National Center for Infectious Diseases  
[Centers for Disease Control and Prevention](#)  
U.S. Department of Health and Human Services



Arizona Department of Health Services  
150 N. 18th Avenue, Suite 140  
Phoenix, Arizona 85007  
Tel: (602) 364-4562 Fax: (602) 364-3198 Toll Free: (800) 344-1540  
Arizona website: [www.azdhs.gov/phs/oids/vector/index.htm](http://www.azdhs.gov/phs/oids/vector/index.htm)  
CDC website: [www.cdc.gov/ncidod/diseases/hanta/hps/index.htm](http://www.cdc.gov/ncidod/diseases/hanta/hps/index.htm)

*For more information contact your local health department or:*

Arizona Department of Health Services 150 N. 18<sup>th</sup> Avenue, Suite 140 ~ Phoenix, Arizona 85007  
Tel: (602) 364-4562 Fax: (602) 364-3198 Toll Free: (800) 334-1540

Arizona website: [www.azdhs.gov/phs/oids/vector/index.htm](http://www.azdhs.gov/phs/oids/vector/index.htm) <<http://www.azdhs.gov/>>

CDC Website: [www.cdc.gov/ncidod/diseases/hanta/hps/index.htm](http://www.cdc.gov/ncidod/diseases/hanta/hps/index.htm) <<http://www.cdc.gov/ncidod/diseases/hanta/hps/index.htm>>